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Specificity of quantitative EEG analysis in adults with attention deficit hyperactivity disorder

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Abstract

Attention deficit hyperactivity disorder (ADHD) in children and adolescents is characterised by excessive restlessness and an extremely poor concentration span, resulting in impulsive and disruptive behaviour. Clinical observation of ADHD in adults suggests that the early hyperactivity is diminished in terms of its impact on social and academic function, while impulsive-type behaviours remain unchanged. EEG studies in children and adolescents with ADHD have reported significantly more low-frequency power (predominantly theta) and less high-frequency power (predominantly beta) than in normal subjects. In normal children and adolescents, a decrease in theta power and an increase in beta power are found with increasing age, leading some researchers to interpret the EEG anomalies in ADHD as evidence of developmental delay. Studies of adults with ADHD compared with normal adult control subjects have found a reduction in the difference between the two groups, suggesting that the reduced beta activity apparent in ADHD children and adolescents changes with age. Adults with ADHD thus appear to have elevated low-frequency power as their predominant EEG difference from normal control subjects. The present study examined whether this EEG profile was specific to adult ADHD patients. Quantitative EEGs were recorded at rest in an eyes-open condition and used to compare 50 adult patients diagnosed with ADHD with 50 non-ADHD subjects (who presented for ADHD assessment but failed to meet the diagnostic criteria) and 50 control subjects. The ADHD group differed from both the non-ADHD and the control groups on the basis of elevated theta activity. The ADHD and control groups did not differ in beta activity, but relative theta was reduced and relative beta power was elevated in the non-ADHD group compared with both the ADHD and control groups. These results suggest that quantitative EEG may be used to differentiate ADHD adults from both normal adults and adults who display some of the symptoms of ADHD, but fail to meet the diagnostic criteria of ADHD.

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1. Introduction

Attention deficit hyperactivity disorder (ADHD) is recognised as a common childhood disorder, although the nomenclature and diagnostic criteria have frequently been redefined since the beginning of this century. Only in recent years has the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders mentioned the existence of the disorder in adults. The current DSM-IV (American Psychiatric Association, 1994) does not provide a specific list of symptoms found in adults, and therefore diagnosis is dependent on the skills and knowledge of the diagnostician. According to Wender (1998), as many as 60–70% of children with ADHD continue to present with some of the symptoms of the disorder in adulthood. Studies of ADHD in adulthood have revealed some interesting findings. Adults with ADHD tend to respond as well as children to stimulant medication, and the effect is just as dramatic. The disorder may be genetically transmitted and biologically mediated. ADHD may be linked to conduct and learning disorders in children, and psychiatric disorders in adults, including alcohol and drug abuse. Finally, it has been suggested that the disorder may occur as a result of a dysfunction in neurotransmitter activity (Wender, 1998).

Early retrospective studies examining ADHD identified a range of symptoms thought to constitute an adult form of the disorder. Menkes et al. (1967) carried out a study in which 14 patients initially assessed with problems of hyperactivity and learning difficulties were traced and assessed 25 years later. This early study provided some evidence that a proportion of adults with problems of hyperactivity and learning difficulties as children continued to manifest a variety of difficulties related to the hyperactive syndrome. Borland and Heckman (1976) and Feldman et al. (1979) reported that the majority of adults previously diagnosed with hyperactive child syndrome were in stable employment and self-supporting, although half of the subjects continued to display symptoms. Both of these studies reported that adults with ADHD had significantly lower self-esteem and a higher level of antisocial behaviour than the control

group. Feldman et al. (1979) reported that, compared to their control group, a higher proportion of adults with ADHD had used marijuana. Drug use was not reported in the Borland and Heckman (1976) study. Other researchers (e.g. Shelly and Riester, 1972; Wood et al., 1976) identified a deviant adult population and, following comprehensive assessments, made a retrospective diagnosis based on the childhood history of these patients. Their findings confirmed that some of the symptoms of the hyperactive child syndrome had continued into adulthood.

Weiss and Hechtman (1986) identified symptoms such as organisational problems and concentration difficulties as characteristic of adults with ADHD. Furthermore, adults with the disorder are often regarded as being rude and impolite, and they typically underachieve in academic and vocational areas. According to Barkley (1990), adults with ADHD tend to be of lower socio-economic status and frequently change jobs, move residence and have more part-time employment. Furthermore, employers rate adults with ADHD as less able to work without supervision, complete assignments and meet the demands of the job. In a prospective follow-up study by Weiss and Hechtman (1986), social skills and interaction problems in adults with ADHD were identified, and this was especially apparent in the area of heterosexual interactions and assertive behaviour. Almost 10% of adults with ADHD had attempted suicide, with 5% dying as a result of suicide or accidental injury. Early peer relationship difficulties often result in interpersonal problems in adulthood; 75% have interpersonal problems, greater heterosocial-skill problems and difficulties with assertiveness (Weiss and Hechtman, 1986; Barkley, 1990). Biederman et al. (1995) also demonstrated that ADHD was a significant risk factor for substance abuse. Barkley et al. (1993) reported that teenagers and young adults with ADHD had less sound driving habits and were more likely to receive traffic citations, particularly for speeding.

Psychophysiological measures, such as electroencephalography (EEG), event-related potentials (ERPs), galvanic skin response and heart rate, have been employed in investigations of brain function in young and adolescent patients with

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